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INSTRUCTION BOOK

**WATTCHER® RF  
MONITOR/ALARM  
MODELS 3126/27/28**



***Electronic Corporation***

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### **MODELS COVERED IN THIS INSTRUCTION BOOK**

**3126**

**3127**

**3128**

## **SAFETY PRECAUTIONS**

The following are general safety precautions that are not necessarily related to any specific part or procedure and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

### **KEEP AWAY FROM LIVE CIRCUITS**

Operating personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always disconnect power.

### **DO NOT SERVICE OR ADJUST ALONE**

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect an RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

### **SAFETY EARTH GROUND**

An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

### **SHOCK HAZARD**

HIGH VOLTAGE is used in the operation of this equipment. DEATH ON CONTACT may result if personnel fail to observe safety precautions. Learn the areas containing high voltages in each part of the equipment. Be careful not to contact high voltage connections when installing or operating this equipment.

### **CHEMICAL HAZARD**

Solvents used to clean parts are potentially dangerous. Avoid inhalation of fumes and also prolonged skin contact.

### **RESUSCITATION**

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

### **SAFETY SYMBOLS**

#### **WARNING**

Warning: Warning notes call attention to a procedure, which if not correctly performed, could result in personal injury.

#### **CAUTION**

Caution: Caution notes call attention to a procedure, which if not correctly performed, could result in damage to the instrument.

The following warnings appear in the text where there is procedures, that if not carefully followed, could be detrimental to operating and maintenance personnel and are repeated there for emphasis.

**WARNING**

Disconnect this unit from ac power source before any disassembly for repair or replacement procedures. The potential for electrical shock exists.

The following equipment cautions appear in the text whenever a procedure, if not properly followed, could put the equipment in danger of damage and are repeated there for emphasis.

**CAUTION**

When the ac power line is connected, be sure correct connections are made to agree with the supply voltage, i.e., a 230 volt line to terminals 6 and 7 etc. Failure to observe correct terminal connections could cause damage to the unit.

**CAUTION**

Do not attempt to check the microammeters with an ohmmeter. Damage to the movement or pointer will result.

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## SECTION I. INTRODUCTION

### 1.1. PURPOSE AND FUNCTION

The Bird WATTCHER® RF monitor is a continuous service equipment designed for the protection and performance observation of radio frequency transmission systems. The Control and Alarm System operates with high reliability electromechanical components working on simple dc and low voltage ac circuits without the use of vacuum tubes or high impedance balanced circuitry. It is designed for use on RF power levels from 1 Watt to 250 kilowatt, and a frequency range from 0.45 to 2400 MHz. In use, a two-element THRULINE® line section will be required. The THRULINE® RF line section will depend upon the type of coaxial transmission line being used in the system. Two plug-in elements are selected to cover the power levels and frequency ranges used.

The function of the element is to detect (sense) the forward or reflected RF power in the line section at any give time. The direction in which the "arrow", on the Element cap, is oriented indicates the direction in which it is sensing the RF power flow in the system. The dc outputs of these detectors are fed respectively to the two panel meters, which indicate directly the forward and the reverse RF energies (incident or reflected power). The reflected power meter has a relay contact incorporated into it, and if the set level is reached, visual and audible alarms will function; and when so wired, external warning devices and transmitter disabling controls can be activated. The monitor is provided with a selector that can be set for operation in one of the two modes as described below.

### 1.2 MODEL DIFFERENCES

The Model 3126 RF Power Monitor/Alarm is identical to the Model 3127 except the Model 3126 has a forward meter with a 15/30/60 kilowatt scale (P/N 2150-090). The reflected meter has a 1.5/3.0/6.0 kilowatt scale (P/N 2150-091).

### 1.3 PERFORMANCE CHARACTERISTICS

#### a. Fail-Safe Mode

The Fail-Safe Mode provides operation of the circuit so that any disruption of the ac line power

supplying the WATTCHER®, or malfunction of the monitors circuitry will furnish an auxiliary alarm and shut-down the transmitting equipment. This mode should be used where an accidental loss of protection from high values of VSWR would be more serious than the possibility of equipment shutdown from abnormal causes.

#### b. Non Fail-Safe Mode

This mode provides operation of the circuit so that a shutdown and alarm will not take place if an accidental disruption occurs on the ac line supplying the WATTCHER® or if a malfunction of WATTCHER® circuitry occurs. It would be used where accidental transmitter shutdown would be more serious than the possibility of operating the equipment without VSWR protection due to abnormal causes.

## 1.4 UNIT SPECIFICATIONS

## MODELS 3126/27/28 WATTCHER® RF MONITOR/ALARM

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<b>Connections</b> .....	Terminal Strip, (13) 8-32 screw terminals, NO/NC control contacts, NO/NC external alarm (8 Amp at 115 Vac noninductive), ac power input and meter inputs.
<b>Power Requirements</b> .....	115/230 Vac, 50/60 Hz (10 W approximately).
<b>Controls</b>	
Front panel .....	Push to reset button, reflected power limit set (screwdriver).
Rear chassis .....	Fail-safe/non fail-safe mode selector switch, fuse "Open" indicator.
<b>Meter Sensitivity</b>	
Models 3126 & 3127 .....	100 $\mu$ A
Model 3128 .....	30 $\mu$ A
<b>Dimensions</b> .....	19" L x 5-7/32"H (482.6 x 132.6 mm) Overall depth 6-5/8" (168.3 mm) Depth behind panel 5" (127 mm)
<b>Weight</b> .....	9 lb (4.1 kg)
<b>Finish</b> .....	Light navy grey (MIL-E-15090)
<b>Meter Power Scales</b>	
Model 3126	
Forward .....	15/30/60 kW
Reflected .....	1.5/3.0/6.0 kW
Model 3127	
Forward .....	5/10/25 kW
Reflected .....	1.0/2.5/5.0 kW
Model 3128	
Forward .....	25/50/100 kW
Reflected .....	25/50/100 kW

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## SECTION II. INSTALLATION

### 2.1. MOUNTING

Mounting for all models covered by this book is identical. Refer to the Installation Drawing, Figure 2-1, which provides dimensions of panel, mounting hole layout, and side view. The WATTCHER® is designed to mount in an American Standard 19 inch Relay Rack. Wired lengths are not critical, and the WATTCHER® unit may be installed where convenient for observation and operation.

The THRULINE® line section may be installed either at the transmitter RF output or between the driver and output stage. Unquestionably the utmost benefit will be derived from the WATTCHER® when the THRULINE® measuring section is placed as close as possible to the transmitter output. This will take into consideration and protect against any defects that may occur beyond this point. For 50 ohm air lines, THRULINE® line sections such as Model 4715, 4610 or 4905 should be installed on 1-5/8, 3-1/8 and 6-1/8 inch lines, respectively. Connections on 50 ohm coaxial cable, such as RG-8A/U, -9A/U, -213/U or -214/U etc., the Bird P/N 4230-053 line section is recommended. The foregoing Models are all two-socket types, so that a plug-in element may be placed in the forward direction and the other in the reflected direction. Methods of making coaxial connections for line sections are described in the respective manuals for these Models.

### 2.2. CONNECTIONS

#### CAUTION

When the ac power line is connected, be sure correct connections are made to agree with the supply voltage, i.e., a 230 volt line to terminals 6 and 7 etc. Failure to observe correct terminal connections could cause damage to the unit.

Schematic Diagram, Figure 2-3, illustrates terminal designations and internal wiring of this equipment. All external connections are made to the terminal board on back face of the monitors chassis. Shielded dc cables with connectors, selected to suit required length, connect dc output of line

sections to terminal board.

### 2.3. SELECTOR SWITCH

The fail-safe/non fail-safe selector switch should be set for desired position. In the fail-safe position, the monitor will alarm whether the contact closes on the reflected power meter, or the ac line power fails. In this mode, the power supply normally energizes the power relay, which will be de-energized when shunted by a meter relay contact closure, or by loss of ac line power.

In the non-fail-safe position, the monitor will not alarm unless ac line power is present to actuate the power relay, regardless of meter relay operation.

Connections should be made to control terminals as directed by position of the mode switch.

### 2.4. ADJUSTMENTS

The two panel meters should be checked for zero set under no power conditions. If the pointer of either meter does not set exactly on zero, turn the adjustment screw with a small screwdriver until they do. These screws are found on the lower portion of the bezel face on the incident meter, and the lower (smaller) of the two holes on the panel just below the reflected power meter.

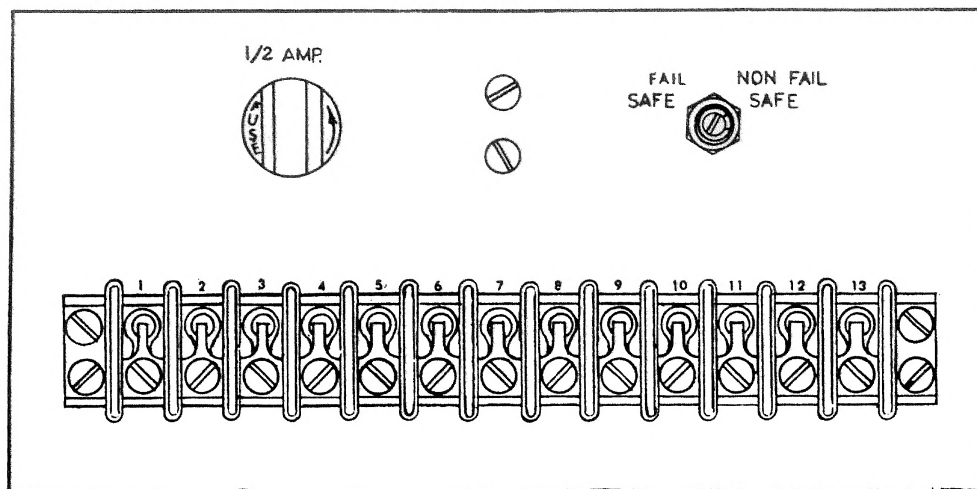


Figure 2-1. Terminal Strip

Table 2-1. Terminal Connection Guide

Connection to the terminal numbers are as follows:

TERMINAL NUMBER	DESCRIPTION
1	Incident (Forward ) power cable - center conductor
2	Ground - Incident and reflected - shield of both cables (1 & 3)
3	Reflected (reverse) power cable - center conductor
4	Ground (chassis)
5	AC line, 115 V
6	AC line, common
7	Ac line, 230 V
8	Fail-safe, normally open; non fail-safe, normally closed
9	Auxiliary alarm system - common for 8 & 10
10	Fail-safe, normally closed; non fail-safe, normally, open
11	Same as 8
12	Transmitter interlock system - common for 11 & 13
13	Same as 10

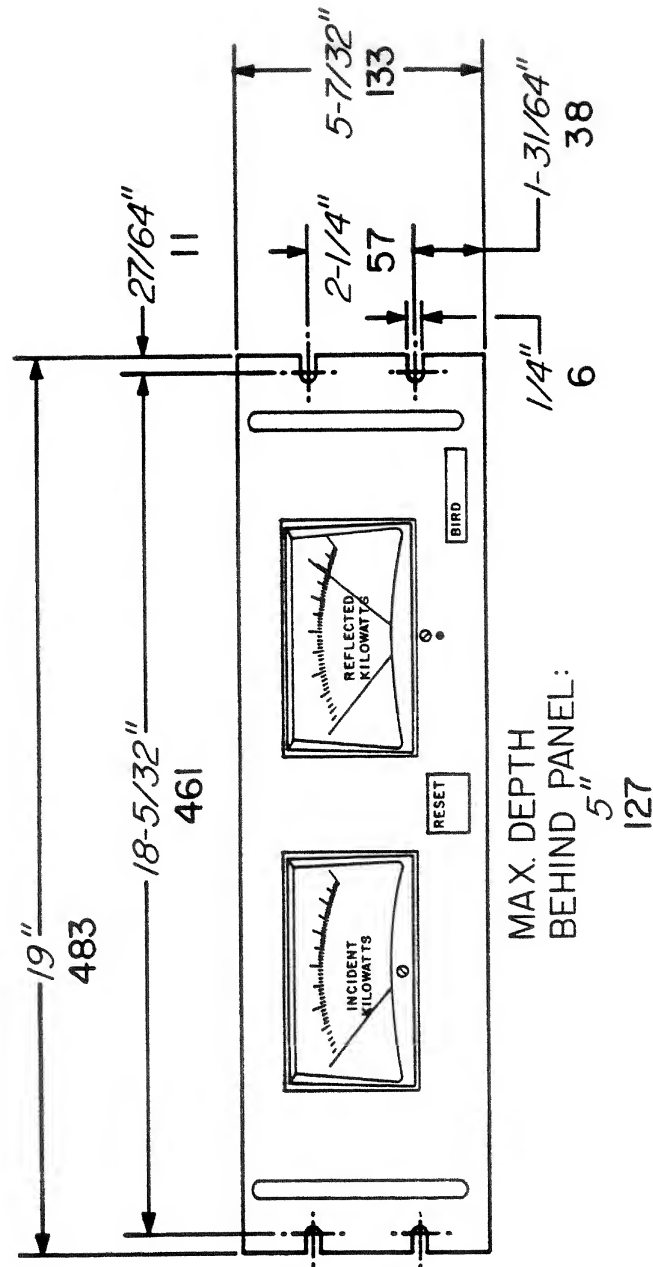
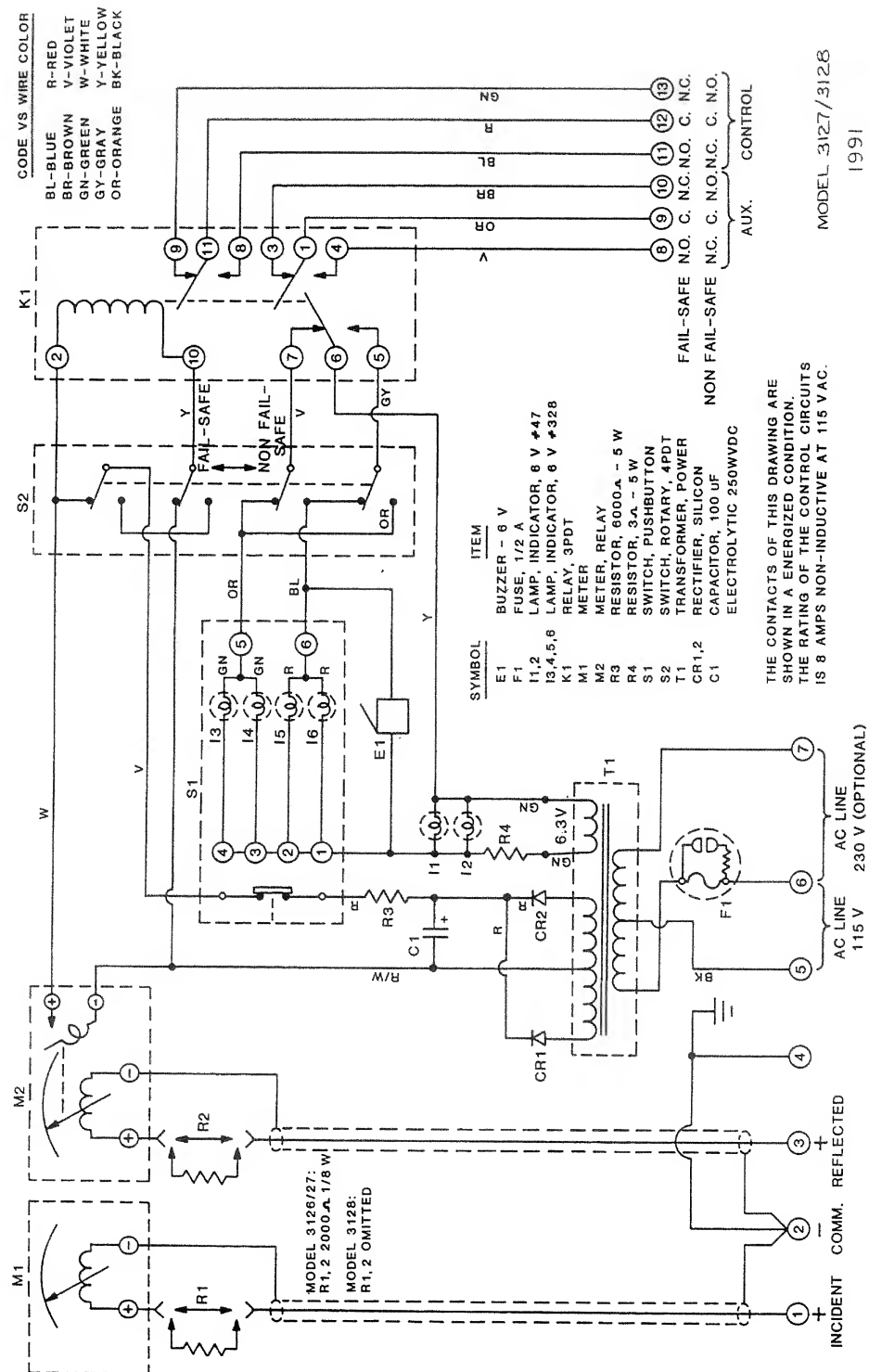


Figure 2-2. Outline Drawing for Models 3126/27/28



**Figure 2-3. Schematic Diagram for Models 3126/27/28**

## SECTION III. THEORY OF OPERATION

### 3.1. GENERAL

The theory upon which the WATTCHER® RF monitor/alarm system performs is fundamentally the same as that of the Bird THRULINE® Wattmeter, as described in "Theory of Operation" section of the THRULINE® (line section) Manual accompanying the equipment. In the WATTCHER®, the incident power meter acts as a continuous monitor of forward power output. This provides a reference against the reflected power value, enabling instant determination of power ratios and VSWR's, whenever required.

The outstanding operational feature of this equipment is in the reflected power indicator, which is a contact meter relay. The trip point is adjustable from the front panel by means of a screwdriver. Reliable operation is assured by a locking coil which remains energized until electrically released. When the relay contact of meter M-2 is closed, a voltage will be applied or removed from relay K-1 (depending upon which mode is selected). Relay K-1 provides DPDT contacts rated at 8A at 115 Vac non-inductive for external control use. A rear-mounted fuse with indicator provides protection of the monitor's circuitry.



## SECTION IV. OPERATING INSTRUCTIONS

### 4.1. PREPARATION

Operation of the WATTCHER® RF monitor, after installation is completed as described in Section II, is relatively simple. Adjust the alarm level on the reflected power meter relay (M-2, right side of panel), to the desired setting. Use a small screwdriver inserted in the larger (upper) hole on the panel just below the meter face bezel. Ensure that the plug-in elements in the line section of transmission line are properly positioned and directed. Make sure that the FAIL-SAFE/NON FAIL-SAFE switch is in the desired mode - see Section II , Installation.

Apply ac line power to the monitor - the meter dials, and green indicator light in face of reset button will be illuminated. Turn on the transmitter; actual power values are indicated directly on the meters. On the more commonly supplied units the meter dials have triple-range scales on both the Incident and Reflected powers. The full scale value shown on the element cap determines the power scale to be read. On certain special order equipments, the meters will be single scale and of the same respective full scale values as the elements.

### 4.2. ALARM ACTION

If the reflected power reading reaches the trip level, the meter relay (M-2) will lock, the buzzer will sound, the green indication on reset button will turn to red, and the power relay K-1 will actuate - switching the auxiliary alarm and interlock circuits. This condition will continue until the reset button is pushed.

During this alarm period, certain benefits may be achieved by holding in the reset button (perhaps while corrective measures or repairs are being made). Holding down the reset button during alarm condition will do the following.

a. Fail-Safe Mode - Keep the transmitter turned off regardless of any other malfunctions which might be remedied. This is useful during repair operations to avoid transmitter start-up under only temporary favorable conditions.

b. Non Fail-Safe Mode - Override the operation of the WATTCHER® and keep transmitter operating regardless of control conditions in the system. It is useful if transmitter operation is to be maintained despite faulty conditions.

After the trouble has been corrected, pushing the reset button momentarily will release the meter relay, restore the normal (green) light on the reset button, and silence the buzzer. This operation is required in either mode.

### 4.3. PERFORMANCE CHECK

The monitor furnishes continuous uninterrupted observation of the performance of the RF transmission equipment due to the continuous operation of the two meters. The advantage of simultaneous surveillance of meter indication is always present without having to rotate the plug-in element to obtain forward or reverse power values.

The forward/reverse RF power ratio is readily calculated from the readings, and VSWRs may be determined from Figures 4-1 and 4-2 following, or in the THRULINE® Wattmeter instruction book.

Following the vertical and horizontal grid, determine intersection of forward and reverse power values. Slanted lines passing closest to this point indicate VSWR.

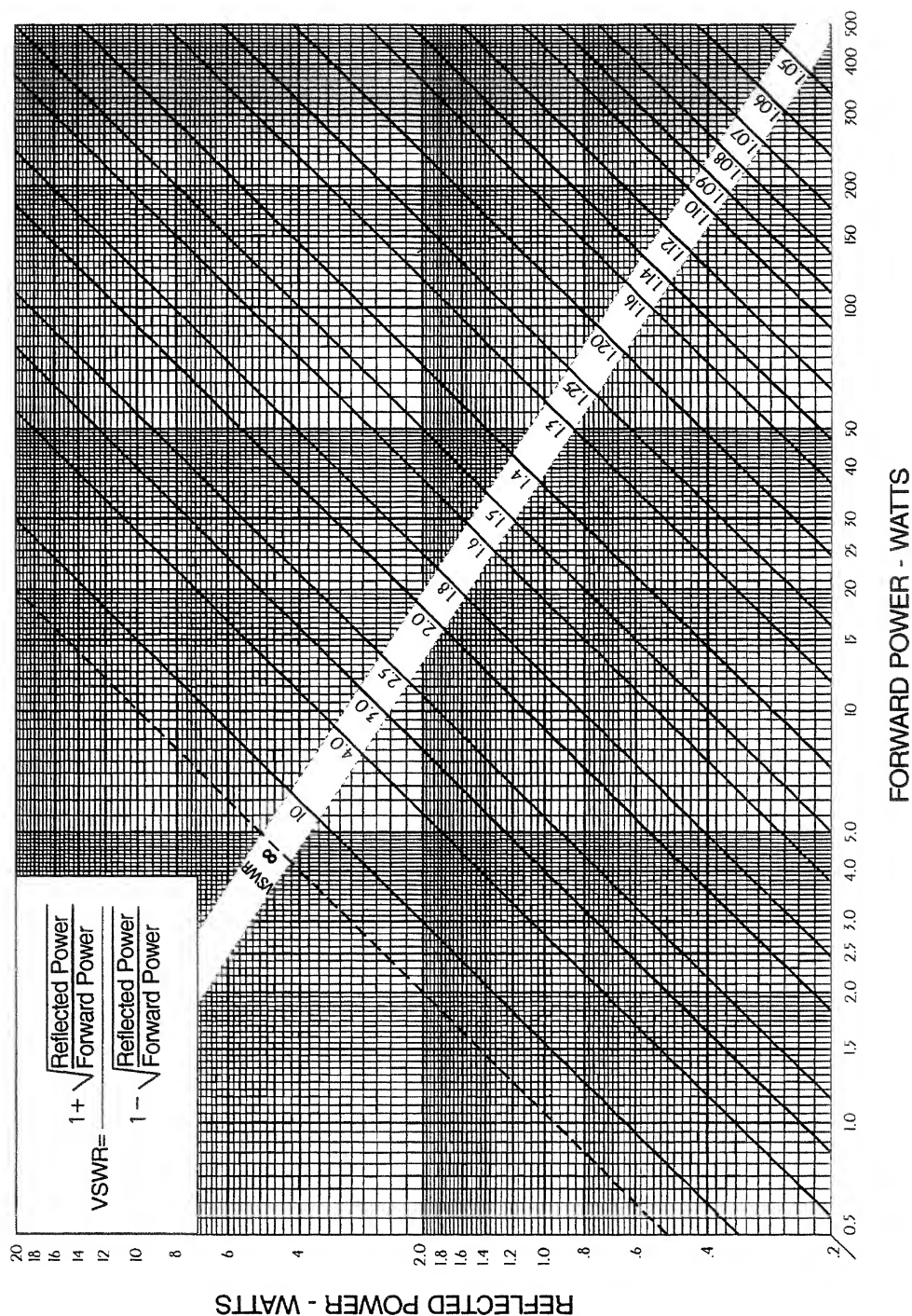


Figure 4-1. VSWR Conversion Nomograph



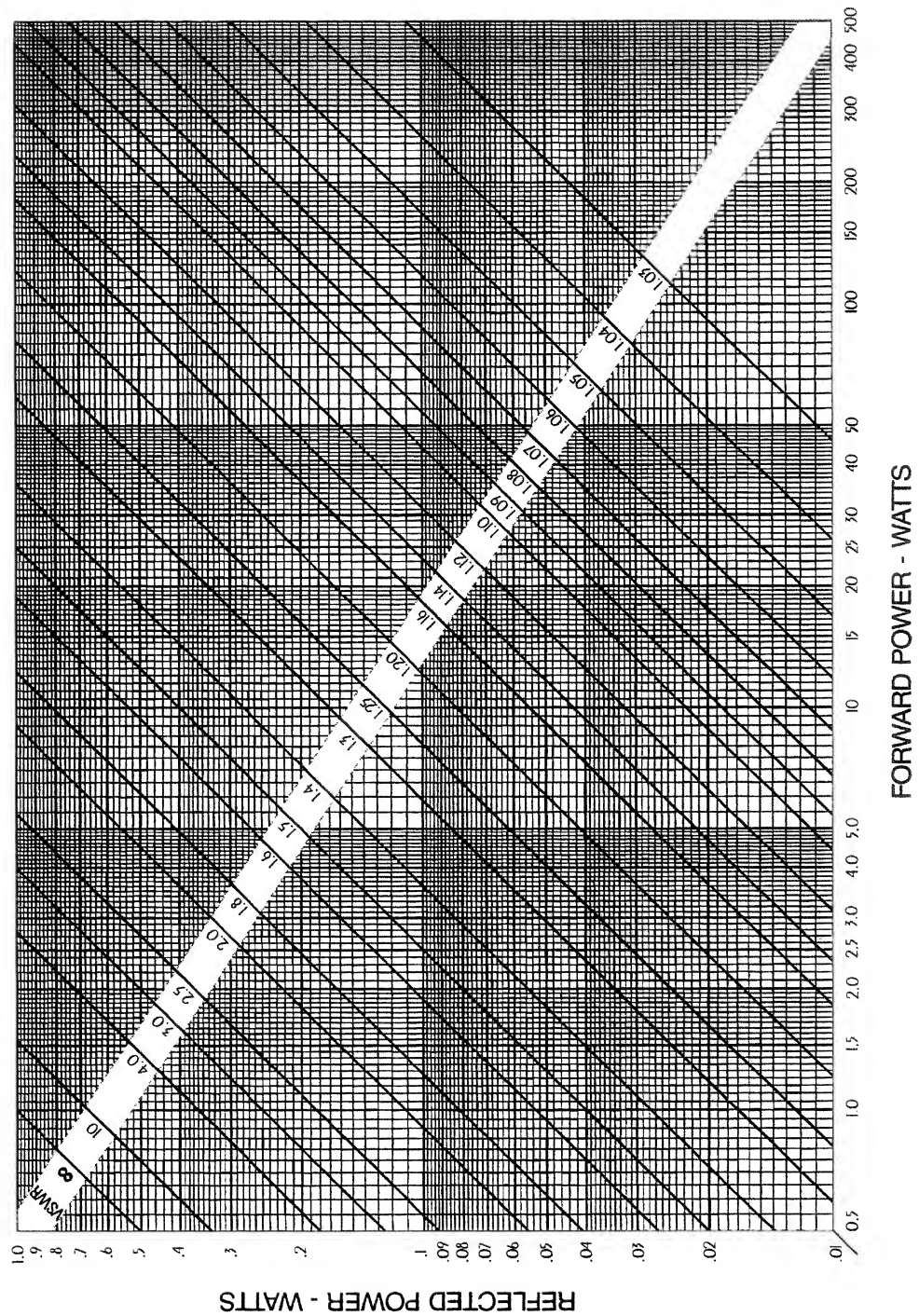


Figure 4-2. VSWR Conversion Nomograph



## SECTION V. MAINTENANCE

### 5.1. GENERAL

The Models 3126/27/28 equipment are relatively simple in their circuitry and constructed of very high quality components throughout. They are designed and built to be durable and completely reliable devices.

The schematic diagram appears in Section II, Installation, Figure 2-3. From observation by anyone familiar with electrical instruments, the functions of the components are readily apparent. Part numbers and descriptions of suggested replaceable items are included in Section VI, Replacement Parts List.

### 5.2. CLEANING

The outside surface of the unit may be cleaned occasionally with a soft cloth dampened with a mild detergent solution. Do not wipe the meter glass with a dry cloth, a static charge will develop and cause an erroneous indication on the meter scale. Cleaning of the inside of the housing may be restricted to times of repair or replacement procedures.

#### WARNING

Disconnect this unit from ac power source before any disassembly for repair or replacement procedures. The potential for electrical shock exists.

### 5.3. PILOT-INDICATOR CIRCUIT

If the meter and push button "green" indicator lights do not illuminate, check the ac power source. Check the line fuse F-1 located on the back face of the monitor chassis. If the power is ON and the line fuse is open, a special neon signal will be lighted in the knob. Twist the knob counterclockwise and pull out to replace the fuse.

When the fuse condition checks OK, lamp burn out will be readily apparent. Meter indicator lamps, I-1 and I-2, are fitted into holes in the lucite light prisms placed behind the panel over the meter scales. These lamps are easily replaced by the following steps:

- a. Remove the 6-32 pan head screws on the edges of the top panel. Take off the top panel.
- b. Pull the flat spring holders that are part of the lamp sockets, straight backwards off the holder bracket.
- c. Remove the light prisms and lamps.
- d. Reverse the above procedure to reassemble.

Indicator lamps (I-3 to I-6) of the push button switch S-1 are replaced from the front panel without using special tools. The light module (containing the display screen, color filters and bulbs) may be removed from the push-button housing. Insert a pointed tool or fingernail under the small tabs on top and bottom side of the button, just behind the face, snap the assembly loose with a slight pull, then draw the whole module directly out from the front. The subminiature flange-based bulbs are easily removed from the back of the module, without disturbing the screen, filters, or sockets. Slip the module back in the housing, noting the key slot on the side of the module (at back) to assure the proper alignment, and snap the assembly back into place.

### 5.4. CHASSIS ACCESS

The top and bottom covers are removed by unscrewing four 6-32 x 1/4 inch pan head machine screws from each cover.

### 5.5. DC CONTROL CIRCUITRY

The power transformer T-1 in this unit is operated well below its rating and should not present any difficulties. The dc control circuit voltage for M-2 meter relay and K-1 relay is provided by a pair of 1N4005 silicon diodes which provide full wave rectification. The diode assembly is mounted on the inside of the chassis adjacent to the transformer. Note the polarity of the diode unit, the positive end is marked. Both diodes must be positioned in the opposite direction, the positive end toward the center lugs. The dc voltage should be 115 V at this point. The 6000 ohm current

limiting resistor, R-3, is connected to the rectifier output.

The rotary mode switch S-2 is rugged, and is unlikely to be a source of any trouble. The power relay K-1 is a plug-in type. It can easily be replaced by pulling it straight out of the socket. It is an ordinary 11 pin type socket. When replacing the relay, rotate the cartridge for alignment of center post nub in the socket.

#### 5.6. MICROAMMETERS

**CAUTION**

Do not attempt to check the microammeters with an ohmmeter. Damage to the movement or pointer will result.

The microammeters are accurate and reliable current measuring instruments which should give long, trouble-free service. The microammeters are not field repairable, but may be replaced using the following procedure:

- a. Remove the top and bottom cover panels, see paragraph 5.4.
- b. Unscrew the handles from the front panel assembly. Use a screwdriver with long shank applied from the back over the edge of the chassis. This will release the panel assembly from the chassis, which should be laid forward (meter terminals upwards).
- c. Remove leads, taking note of the wire locations.
- d. Loosen, and completely remove the pusher screws from the slide tabs that secure the meter bezel. Pivot the slide tabs on both sides in towards the meter movement. Bezel is now free.
- e. Remove the bezel from front of panel, thus releasing the meter.
- f. Remove the lamp bracket and slide tabs by unscrewing the two 6-32 hex nuts located at the top-back of the meter. The lamp bracket and slide tabs can now be completely removed.

- g. Reverse the procedure to reassemble.

These meters may be tested for full scale sensitivity. However, this should be attempted only by one familiar with circuits and instruments used for testing of sensitive dc microammeters. Test the meter as a microammeter in series with a low voltage battery, variable resistor and an external microammeter. Full scale current on M-1 or M-2 should be 100 ua  $\pm 2$  percent for the Model 3126/27 and 30 ua  $\pm 2$  percent for the Model 3128 WATTCHER®.

## SECTION VI. REPLACEMENT PARTS LIST

### 6.1. MODELS 3126/27/28 WATTCHER®

ITEM	QTY	SYMBOL	DESCRIPTION	PART NUMBER
1	2	CR-1 & 2	Rectifier, silicone diode	5-2067
2	1	E1	Buzzer, alarm	5-362
3	1	F1	Fuse 0.5 A 3AG1/2	5-721-2
4	2	L1 & L2	Meter lamp no. 47	5-357
5	4	L3-6	Reset lamp no. 328	5-358
6	1	K1	Power relay, 3PDT	5-360
7	1	M1	Meter, triple scale, incident power Model 3126, 100 uA 15/30/60 kW scale Model 3127, 100 uA 5/10/25 kW scale Model 3128, 30 uA 25/50/100 W scale	2150-090 2150-042 2150-045
8	1	M2	Meter, triple scale, reflected power Model 3126, 100 uA 1.5/3.0/6.0 kW scale Model 3127, 100 uA 0.1/2.5/5.0 kW scale Model 3128, 30 uA 25/50/100 W scale	2150-091 2150-043 2150-044
9	1	R-3	Resistor, WW 6000 ohm 5 W	5-365-4
10	1	R-4	Resistor, WW 3 ohm 5 W	5-365-2
11	1	S-1	Alarm reset switch	5-363
12	1	S-2	Rotary mode selector switch	3127-022
13	1	T-1	Power transformer	3127-047
14	2	R-1 & R-2	Resistor 2K, 1/8 W (3126 & 3127 ONLY)	5-157
15	1		Relay socket	3127-017
16	2		Handle, oval	5-957
17	2		Terminal strip (3-lug) (diode)	5-401-2
18	1		Capacitor 100 uf 250 Vdc	5-1920
19	1		Terminal strip (2-lug)	5-373-1
20	1		Terminal strip (13 position)	5-400-13